REMARKS

Claims 1-16 and 18-29 are pending in the application. Claim 5 has been amended to correct a spelling error. No new matter has been added. Reconsideration of the claims is respectfully requested.

Provisional Double Patenting Rejections

Claims 1-16 and 18-19 were provisionally rejected under the judicially created doctrine of obvious-type double patenting as being unpatentable over claims of copending applications 10/014,278 and 10/014,277.

Applicant notes that these double patenting rejections are provisional. These rejections will not be addressed until one of the applications, either the applications used as the basis for the rejections, or the present application, is issued as a patent. At that time, Applicant will be able to properly address the provisional double patenting rejection according to MPEP § 804. Applicant does not acquiesce to the reasons stated for the provisional double patenting rejections.

Rejection under 35 U.S.C. § 102

Claims 1-6, 18, and 19 are rejected under 35 U.S.C. §102(b) as being anticipated by Chang-Hasnain et al. (U.S. Patent 6,233,263) (Chang). Applicant notes that, since Chang issued as a patent on May 15, 2001 and the present application was filed on December 11, 2001, the period of time between Chang issuing and the present application being filed was less than twelve months. Accordingly, a rejection under § 102(b) is improper.

Chang teaches a monitoring and control assembly for an optical system that includes a tunable laser (Abstract). A first photodetector is provided and a wavelength selective filter is tilted at an angle relative to the optical axis that provides an angular dependence of a wavelength reflection of the wavelength selective filter and directs the reflected output beam towards the first photodetector (Abstract). Various embodiments are shown, e.g. FIGs. 4, 6, 7, 10, 12-18 and 20, where first and second photo diodes (24 and 28) are used to detect different optical signals from the wavelength selective filter (20).

The invention of independent claim 1 is directed to a method of stabilizing an operating wavelength of a laser. The method comprises illuminating an optical element with light output from the laser to produce an interference pattern, where the optical element is a non-parallel

etalon. At least three different portions of the interference pattern are detected to generate at least three respective detection signals. A feedback signal is generated using the at least three detection signals. The operating wavelength of the laser is adjusted in response to the feedback signal.

To anticipate a claim, the reference must teach every element of the claim. "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). "The identical invention must be shown in as complete detail as is contained in the ... claim." *Richardson v. Suzuki Motor Co.*, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). Therefore, all claim elements, and their limitations, must be found in the prior art reference to maintain a rejection based on 35 U.S.C. §102. Applicant respectfully submits that Chang does not teach every element of claim 1, and therefore fails to anticipate claim 1.

In particular, Chang fails to show generating a feedback signal using the at least three detection signals. It is important first to note that, in all of the figures that show a control loop, i.e. FIGs. 7, 14 and 20, Chang shows the use of only two photodetectors to generate a control signal. It is stated in the Office Action that Chang teaches the detection of at least three different portions of the interference pattern to generate at least three respective detection signals at col. 4, line 61 onwards and at col. 7, lines 25 onwards. Applicant respectfully disagrees and contends that, although Chang teaches the use of an array of detectors, Chang teaches that the feedback signal fed to the laser is based only on signals received from two of the photodetectors.

At col. 4, lines 61-65, the following is stated in Chang: "Two or more photodetectors may be employed. In one embodiment, the array of photodetectors 24 is utilized. More than one photodiode can be used greater discrimination in monitoring and control of laser 12, as more fully described hereafter [sic]". Thus, in this portion of the specification, Chang only states that it is possible to provide two or more photodetectors and that greater discrimination can be obtained by using more than one detector over the case where only one detector is used. It is important to note that what is "more fully described hereafter" is only a method of controlling the wavelength of the laser based on signals from two photodiodes, not three, as is further explained in the following paragraphs.

At col. 5, lines 58-67, it is stated: "For dense WDM applications, where precise wavelengths are required, differential detection scheme [as opposed to the single photodetector

schemes shown in FIGs. 1-3] is utilized to further enhance accuracy. A differential detector scheme *compares the output from a pair of photodetectors* 24. *When there is an array, there is still comparison between a pair of adjacent or non-adjacent photodetectors* 24, one comparison at a time. When a pair of photodetectors is used a difference in response of the two photodetectors is used to determine the wavelength deviation from a pre-set wavelength." (emphasis added) Thus, the only approach to controlling the laser that Chang teaches is by comparing the signals from two different photodetectors. This is consistent with the circuits shown in FIGs. 7, 14 and 20.

The use of different photodetectors is further explained at col. 7, lines 25-31, where it is stated: "In various embodiments, laser 12 can be coupled with any number of photodetectors. With a plurality of photodetectors, *different pairs of photodetectors can be used for wavelength subsets in a broader wavelength range. Thus the use of multiple pairs of photodetectors provides coverage for any selected wavelength range*. An array of photodetectors can be used." (emphasis added). Thus, Chang explains that although multiple photodetectors can be used, they are only used two at a time: the use of a pair of photodetectors allows the use to control the laser over a wavelength range associated with that pair of photodetectors. Different pairs of photodetectors permit the measurement of wavelength over respectively different ranges of wavelength.

In view of Chang's statements summarized above, it becomes clear that Chang does not teach using three detector signals to generate a feedback signal, but only teaches the use of two detector signals to generate the feedback signal. Consequently the operating wavelength of Chang's laser is adjusted based on the use of only two photodetectors, not three photodetectors.

Since Chang fails to teach all the steps of the method of claim 1, claim 1 is not anticipated by Chang.

Independent claim 19 is directed to a system for stabilizing an operating wavelength of a laser, comprising means for illuminating a non-parallel etalon with light output from the laser to produce an interference pattern, means for detecting at least three different portions of the interference pattern to generate at least three respective detection signals, means for generating a feedback signal using the at least three detection signals, and means for adjusting the operating wavelength of the laser in response to the feedback signal.

For reasons similar to those discussed above with respect to claim 1, Chang fails to teach the means for generating a feedback signal using the three detection signals. Accordingly, Chang fails to teach all the elements of claim 19 and so claim 19 is not anticipated by Chang.

Dependent claims 2-6 and 18, which depend from independent claim 1, were also rejected under 35 U.S.C. §102(b) as being unpatentable over Chang. While Applicant does not acquiesce with the particular rejections to these dependent claims, it is believed that these rejections are moot in view of the remarks made in connection with independent claim 1. These dependent claims include all of the limitations of the base claim and any intervening claims, and recite additional features which further distinguish these claims from the cited references. Therefore, dependent claims 2-6 and 18 are also not anticipated by Chang.

Regarding claims 4 and 5, Applicant respectfully disagrees that Chang's photodetector array teaches the claimed relationships. Chang makes no comments regarding the relationship between the period of the interference pattern and the spacing between detector elements, and fails to teach that there is a regular spacing between the three detector elements that generate the three detector signals used to generate the feedback signal.

Regarding claim 6, Applicant further disagrees that Chang's disclosure of a photodiode array anticipates the claimed invention. According to claim 6, there exist additional corresponding detector elements positioned are the same phase in the interference pattern as the "at least three detector elements". There is nothing in Chang that teaches this is the case. For this condition to occur, there exists a specific relationship between the period of the interference pattern and the spacing between detector elements. Chang is silent as to such a relationship.

Rejections under 35 U.S.C. § 103

Claims 7-16, 20-23 and 25-29 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Chang and further in view of Fencil (U.S. Patent No. 4,171,416), Ballard et al. (U.S. Patent No. 4,515,478) (Ballard) and Hanse (U.S. Patent No. 4,566,794).

It is stated that Chang does not expressly show the summing and fringe analysis of the detection signals. Applicant respectfully disagrees. Chang explicitly shows control loop circuits, in FIGs. 7, 14 and 20, based on feeding inputs from two photodiodes into a differential amplifier (34). The output from the differential amplifier is fed into an integrator (36) and then back to the laser (12). Accordingly, the circuits shown by Chang provide the analysis of the optical signals.

Three criteria must be met to establish a *prima facie* case of obviousness. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference. Second, there must be a reasonable expectation of success. Finally, the prior art reference, or combination of references, must teach or suggest all the claim limitations. MPEP § 2142. Applicant respectfully traverses the rejection since the prior art fails to disclose all the claim limitations, and there would be no motivation to combine the references in the manner suggested in the Office Action.

It is stated in the Office Action that Fencil shows an apparatus for analyzing coherent radiation using a stepped etalon having several detectors to sample different phases of the fringes. It is also stated that Ballard and Hanse both show the (sine/cosine) fringe analysis, and that at the time of the invention one of ordinary skill would have used the signal analysis taught by Ballard and Hanse in order to determine the different characteristics of the light being measured including the determination of the intensity of the light. It is also stated that it is of common knowledge to one of ordinary skill in the art that sampling equivalently across one fringe involving basic trigonometry of sine and cosine waves is an indicator of the intensity of the sampled beam in that if all the intensity measured by the detectors overall is very high, indicating the intensity of the source beam is high also. It is also stated that the measurement of the peaks (constructive interference) of the fringes would inherently indicate the intensity of the source beam although the true intensity may not be determined.

Clarity of 103 Rejection

The rejection based on Fencil, Ballard and Hanse is unclear. In particular, Applicant is confused as to which references are to be applied to which claims, and contends that a specific description of the rejection is not provided. For example, claim 7 is directed to summing signals from three detector elements and their respective additional detector elements. This claim contains no limitations as to how the signals are analyzed, and so the relevance of Ballard and Hanse to this claim is questionable. In addition, the rejection appears to be based, in large part, on the Examiner's assertion that sampling equivalently across one fringe automatically leads to an indication of the intensity of the light. In such a case, the references would appear to be irrelevant to, for example, claims 20 and 29. The Examiner is requested to clarify which of the cited references are to be applied to each of claims 7-16, 20-23 and 25-29.

Notwithstanding the confusion regarding the use of references in the 103 rejection, the rejection addressed as fully as possible.

<u>Dependent claims 7-16</u>

These claims depend from claim 1, which was shown above to be not anticipated by Chang.

Claim 7 is directed to the respective additional detector elements of claim 6, where the detection signals from the each of the at least three detectors and their respective additional detector elements are summed to form summed signals for each phase portion of the interference pattern. This is discussed, for example, at page 17, lines 3-11 with reference to FIG. 5. None of the cited references teach or suggest summing of signals from different detector elements that correspond to the same phase portion of the interference pattern, and then generating the feedback signal from the summed signals.

Claim 8 is directed to summing the signals from the at least three detection elements to produce a signal indicative of a power level of the laser. In addition, according to claim 8, these three signals are also used to generate a feedback signal control the operating wavelength of the laser. Thus the same three signals can be used to a) control the laser's wavelength and b) determine the laser's power. It is stated that this would be of common knowledge to one of ordinary skill, but Applicant strongly disagrees. None of the references teach or suggest that the signals used for measuring/controlling wavelength can also be used to determine laser power. In fact, Fencil teaches the use of separate detectors (36) and (38) (FIG. 1) to detect the power/energy of the laser, and does not teach or suggest the use of signals used in phase difference detection to make a power measurement.

The omission of an element and the retention of its function is an indicia of unobviousness *In re Edge*, 359, F.2d 896, 149 USPQ 556 (CCPA, 1966), MPEP 2144.04.II.B. In this situation, Fencil teaches the use of a detector array to detect the interference pattern and a separate power monitor to detect the output power. The present invention is directed to the use of at least three detector elements to i) detect the interference pattern and ii) monitor the power. Thus, the invention of claim 8 permits the detection of the output power without the use of a separate power monitor. Under the criteria set forth in *In re Edge*, this is not obvious.

Claim 9 is directed to compensating the detection signals for a light intensity distribution function. This is not taught or suggested in the cited references.

Regarding claims 10 and 11, none of the cited references teach or suggest the use of phase signals to generate the feedback signal that controls the laser wavelength, nor do the references teach or suggest the use of three detector elements to generate the I signal, indicative of the laser power.

Regarding claims 12-16, neither Ballard nor Hanse teach or suggest the phase signals as claimed. In claim 12, the sine signal is given as $\sin(\varphi) = (T-R)/(I\sqrt{3})$, the cosine signal is given as $\cos(\varphi) = (S-I)/I$ and the phase signal $\varphi = \text{arctangent}((\sin(\varphi))/(\cos(\varphi)))$. These signals are all based on the three detector signals, *viz.* R, S, and T.

Hanse does teach the generation of phase signals, but these are different from those claimed. First, Hanse's phase signals (see FIG. 3) are based on the output from four detectors, A, B, C, and D, not three detectors. Second, Hanse's cosine signal is given by $\cos\Delta\Phi = (C-A)/(C+A)$ and is dependent only on two of the four detector signals, A and C. It is, therefore, independent of B and D. Third, the sine signal is given by $\sin\Delta\Phi = (B-D)/(B+D)$, and is dependent on only B and D, and is independent of A and C. These relationships are different from those set forth in claims 12-16.

Despite the statement in the Office Action to the contrary, Ballard fails to teach or suggest the generation of the claimed phase signals based on three detector signals. Instead, Ballard teaches the use of an array of detectors that use a common terminal (208), and determines the presence of a fringe pattern, using Kirchoff's law, by comparing the signal associated with a single element against the averaged detector signal (col. 4, lines 14-60).

Independent claims 20 and 29

Independent claim 20 is directed to a method of monitoring light output by a laser, comprising producing a periodic optical interference pattern by illuminating an optical element with the light output by the laser and detecting at least three different portions of the periodic optical interference pattern to generate at least three respective detection signals. A power signal indicative of output power from the laser is generated using the at least three detection signals.

Independent claim 29 is directed to a system for monitoring light output by a laser, comprising means for producing a periodic optical interference pattern by illuminating an optical

element with the light output by the laser and means for detecting at least three different portions of the periodic optical interference pattern to generate at least three respective detection signals. The system also includes means for generating a power signal indicative of output power from the laser using the at least three detection signals.

None of the cited references teach or suggest forming an interference pattern using light from a laser, detecting at least three different portions of the interference pattern and then producing a power signal indicative of the output power from the laser. Chang, Hanse and Ballard are silent as to the determination of a signal indicative of output power, and Fencil teaches using a power detector (38) to detect the output power, not signals from an interference pattern.

None of the references teach or suggest the last elements of claims 20 and 29, i.e. generating the power signal indicative of the output power from the laser using the at least three detection signals, or means for same. It is stated in the Office Action that it is of common knowledge to one of ordinary skill in the art that sampling across one fringe is an indicator of intensity of the sampled beam. The Examiner has effectively taken Official Notice of this fact, without expressly doing do. Applicant respectfully requests that the Examiner provide evidence of the allegation that this step is well known in the art. Applicant respectfully suggests that it is more common to produce a power signal using a single photodetector element, for example as taught by Fencil, than to produce an interference fringe pattern, detect at least three different regions of the fringe pattern and then generate a power signal indicative of the output power from the laser.

Thus, the proposed references fail to teach or suggest all of the elements of claims 20 and 29.

Furthermore, one would not be motivated to combine the references in the manner suggested. Chang only teaches using the signals from two photodetectors at any one time, rather than at least three. Chang fails to teach measuring the output power from the signals detected by the photodetectors. None of the other references teach producing a power signal from different parts of an interference fringe pattern. Therefore, one of ordinary skill in the art would not be motivated to combine references to come up with something that the references do not, in combination teach. Furthermore, Hanse teaches a system for interfering two light beams together where there is a difference in frequency between the two beams: this frequency difference arises from the rotation of the fiber gyro. The difference in frequency results in a movement of the

fringe pattern. The present invention, on the other hand, is related to measuring the output power from a laser by taking an output beam from a laser, producing an interference pattern with the one output beam, not two beams, and then determining the output power from the resulting interference pattern. As can be seen, Hanse teaches something quite different from the present invention, and so one would not be motivated to use Hanse's teachings to determine the output power of a laser.

Also, Fencil and Ballard are directed to systems used to determine the presence of coherent (laser) light against an incoherent background. This involves the formation of interference fringes which are detected in various ways, but the interference fringes are not used for measuring the power level of the laser. In fact, Fencil teaches the use of a separate power detector (38), which does not use a beam with interference fringes. Accordingly, one of ordinary skill would not be motivated to combine the references in the manner proposed because the references do not relate to the invention.

Dependent Claims 21-23, 25-28

Dependent claims 21-23 and 25-28, which depend from independent claim 20, were also rejected under 35 U.S.C. §103(a) as being unpatentable over the proposed combination of references. While Applicant does not acquiesce with the particular rejections to these dependent claims, it is believed that these rejections are moot in view of the remarks made in connection with independent claim 20. These dependent claims include all of the limitations of the base claim and any intervening claims, and recite additional features which further distinguish these claims from the cited references. Therefore, dependent claims 21-23 and 25-28 are patentable over the proposed combination of references.

Regarding claim 21, there is nothing in the proposed combination of references that teaches or suggests using a non-planar etalon to produce an interference pattern, and then detecting parts of that interference pattern to produce signals that are used to generate a power signal indicative of the output power from the laser.

Regarding claim 23, there is nothing in the proposed combination of references that teaches or suggests that a wedged etalon is used to generate the interference pattern from which a power signal is generated that indicates the output power of the laser.

Regarding claim 27, there is nothing in the proposed combination of references that teaches or suggests that the at least three detection signals, associated with different portions of the interference pattern, be summed together top produce the power signal.

Regarding claim 28, there is nothing in the proposed combination of references that teaches or suggests generating a feedback signal from the same signals as are used to generate the power signal, and to stabilizing the wavelength of the laser using the feedback signal.

Claim 24

Claim 24 was rejected under 35 U.S.C. § 103(a) as being unpatentable over the proposed combination of Chang, Fencil, Ballard and Hanse in view of Russell (U.S. Patent No. 6,151,114). It is stated in the Office Action that Chang, Fencil, Ballard and Hanse fail to teach a non-parallel etalon having at least one curved surface, that Russell teaches such an etalon and that it would have been obvious to one of ordinary skill in the art to use Russell's etalon in order to differentiate the effects of the arrival angle of the beam from the wavelength of the beam.

Russell teaches the use of a dome etalon (70) which presents a range of angles to the incident laser energy at the same time (col. 7, lines 55-59).

Applicant does not admit that Russell's domed etalon is a non-parallel etalon: the two surfaces of the etalon appear to be concentric arcs, and so the two surfaces can be considered to be parallel to each other.

More importantly, however, the motivation to combine Russell with the Chang, Fencil, Ballard and Hanse is lacking. Russell describes a coherent laser warning system for detecting the presence of incident radiation which is substantially coherent, such as the light from a laser (col. 3, lines 39-42). The method of claim 24 is directed to monitoring light output from a laser, and so there is no question that a laser is present. Accordingly, there is no need to make a determination as to whether the light is coherent or not. Furthermore, Russell does not teach or suggest how to measure the power in an output laser beam by detecting different portions of an interference pattern produces by the domed etalon. Accordingly, Russell does not help one of ordinary skill in the art to come up with the invention of claim 24. Furthermore, the purported motivation for combining Russell with the other references is to differentiate the effects of the arrival angle of the beam. There is no issue, however, with the present invention as to the arrival angle of the

beam. The alleged motivation is, therefore, irrelevant, and one of ordinary skill in the art would not be motivated in the alleged manner to combine Russell with the other references.

Conclusions

In view of the reasons provided above, it is believed that all pending claims are in condition for allowance. Applicant respectfully requests favorable reconsideration and early allowance of all pending claims.

If a telephone conference would be helpful in resolving any issues concerning this communication, please contact Applicant's attorney of record, Iain A. McIntyre at 612-436-9610.

Respectfully submitted,

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